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(54) Stack handling apparatus

(57) Handling apparatus for packaging flat articles such as tea bags (P) comprises a vertical guide (2) in which the bags are stacked in a column while resting on engagement fingers (18) that move downwards to maintain the top of the building stack at a prescribed height. The stack is ejected into a container (C) immediately below the guide by a pusher member (20) which drives the stack downwards, the engagement fingers being meanwhile retracted from the stack. By driving the stack downwards with an acceleration greater than gravity as it is packed into the container, the stack can be kept stable.

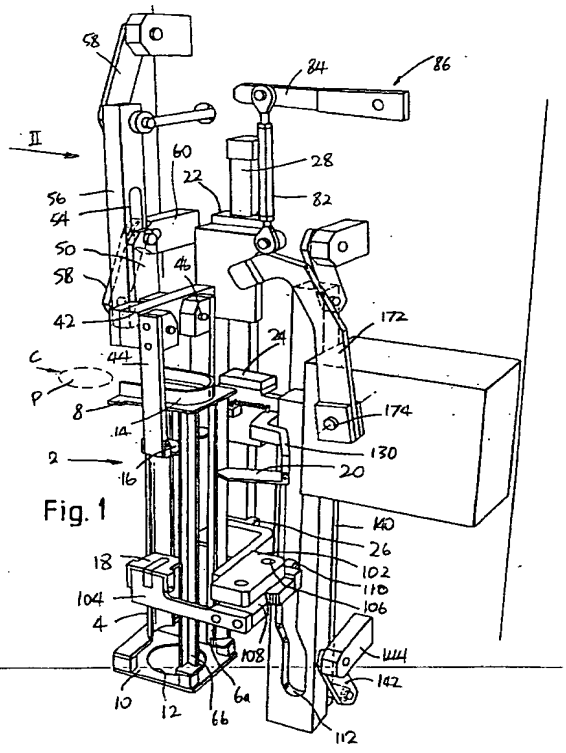

Fig. 1

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Description

This invention relates to apparatus for handling articles which are to be collated in stacks and transferred to another location. It is particularly concerned with the collation of relatively flat articles, such as infusion packets, and their insertion into containers, but it is not necessarily so limited.

It is often required to package articles in an ordered way by collating them into stacks before inserting the stacks into containers. The size and shape of a container is normally adapted to retain the articles in their ordered arrangement but during the transfer of the articles into the container precautions may be needed to maintain the stack intact during the transfer. The individual articles are not positively secured together so the stack can easily become unstable. Factors which affect the stability of the stack include the number of articles in the stack, the non-rigidity of the individual articles, and their density and coefficient of friction. Shape is another important factor, as in the case of typically pillow-shaped infusion packets which are considerably less stable than flat-faced articles in a stack.

Because the stack may be disrupted during transfer to the container, it is known to clamp a stack together at its ends to hold it stably while it is being inserted into a container. This can be done by moving the stack transversely to its axis into the container. It is also known to employ a holder that inserts the stack axially into a container (GB 2156766). However, the holder is itself loaded by transferring the stack laterally from the collating guide in which it has been assembled, while there must be additional free space within the container when the holder is removed after depositing the articles, leaving the articles more liable to move about during transport and handling of the container.

The present invention is concerned with a novel handling apparatus and method that allows a stack of articles to be inserted axially from a collating guide into a container while reducing any risk of the stack becoming disordered as it is inserted.

According to one aspect of the invention, there is provided apparatus for handling a stack of articles, comprising a guide for containing the articles as they are gathered in a stack extending longitudinally within the guide, support means on which the building stack rests within the guide, and discharge means behind the stack displaceable longitudinally within the guide to travel with the completed stack as it emerges through an exit end of the guide.

Further support means may be arranged to be insertable into the guide to provide a support for a succeeding stack after the completion of each preceding stack, so that the articles can be collated into stacks essentially continuously.

It is preferred to arrange that the guide extends downwardly to said one end so that the stack rests upon the support means as it is built. The discharge means are preferably arranged to be driven so that they bear on the completed stack and maintain contact with the stack substantially to the exit end of the guide. It is possible, however, for the discharge means to follow close behind the exiting stack. This may be done in particular when the stack travels downwardly out of the guide and so moves itself under gravity. In such circumstances it may be necessary only for the discharge means to remain sufficiently close to the rear of the stack and to prevent the last one or two articles of the stack separating and tilting over due to disturbances in their motion.

In most circumstances, however, it will be preferred to have a discharge means in constant contact with the stack. That is to say, as the stack leaves the guide the discharge means will accelerate with the stack at a rate not substantially less than gravitational acceleration, but preferably greater. It is particularly preferred to arrange that said discharge means acts on the stack to cause it to accelerate it at a rate greater than its rate of acceleration in free fall. This ensures that the entire stack is forced to bear against the discharge means as it is ejected, so that the stack is forcibly maintained intact during its transfer from the guide. However, to limit possible side effects the acceleration rate for many articles is preferably not subtantially more than 1¼g.

In one arrangement having a downwardly extending guide, the support means and the discharge means move together with the completed stack at a generally uniform rate until the support means are withdrawn from under the stack at the bottom of the guide. At this point the discharge means accelerate to push the stack from the guide and maintain contact with the stack to the bottom of the guide. A carton or other container can be arranged directly below the guide to receive the stack as it is driven downwards into it by the discharge means.

According to another aspect of the invention, there is provided apparatus for handling a stack of articles, comprising a downwardly extending guide for receiving the articles as the stack is built, lower support means on which the building stack rests in the guide, and discharge means displaceable within the guide to bear on the top of the completed stack as it exits through the bottom of the guide, the discharge means maintaining contact with the top of the stack at least substantially to the bottom of the guide.

The invention also includes a method of handling articles comprising collating a stack of the articles in a guide locating an open container longitudinally aligned with the guide and transferring the stack longitudinally into the container while displacing a discharge device behind the stack to travel with the stack at least substantially to an exit end of the guide as the stack emerges through said exit end, to control the stability of the stack during transfer to the container.

In performing this method the stack is preferably accumulated in a downwardly extending guide and is transferred to a container below the guide by acting on the stack from above to accelerate it at a rate greater than the rate of gravitational acceleration.

By way of example, an embodiment of the invention

will be described in more detail with reference to the accompanying drawings, in which:

Fig. 1 is a front perspective view of part of a handling apparatus according to the invention, for building and ejecting a stack of articles,
Fig. 2 shows a part of the apparatus in the direction of the arrow II in Fig. 1,
Fig. 3 is a plan view showing further parts of the apparatus of Fig. 1,
Fig. 4 is a detail side view of one of displacement mechanisms of the apparatus,
Fig. 5 is a plan view showing another part of the apparatus, and
Figs. 6 to 12 are schematic illustrations of the apparatus at different stages in a sequence of collating articles in a stack and ejecting that stack into a carton.

In Fig. 1 can be seen guide 2 in the form of a hollow vertical column in which the stacks of articles are built up. The structure of the guide comprises three spaced vertical members, namely an arcuate wall member 4 and a pair of narrower angle members 6a,6b, secured together by upper and lower plates 8,10. The lower plate 10 has a circular aperture 12 to the cross-section of which the facing sides of the vertical members 4,6a,6b conform, and the upper plate has a similar aperture, the sides and rear of which are enclosed by a barrier 14. The guide is thus arranged to receive circular packets P conveyed to it in the direction C by a delivery conveyor which is not shown but which may be entirely conventional in its construction. As they enter the guide, the packets land onto one or other pairs of upper and lower engagement fingers 16,18 which can project into the guide through the spaces between the arcuate member 4 and each angle member 6a,6b. A single pusher member 20 can similarly project into the guide through the space between the angle members 6a,6b.

Respective carriages 22,24,26 for the upper and engagement fingers 16 the pusher member 20 and the lower engagement fingers 18 are vertically movable along a fixed slide column 28 mounted on the machine frame of which front plate 30 can be seen behind the guide 2, thereby to displace the fingers and the pusher member along the guide. The fingers and pusher member are mounted on their carriages through mechanisms which allow them to move transversely into and out of the guide. The mechanisms for these vertical and transverse movements will now be described.

The carriage 22 for the upper fingers 16 has a forwardly projecting bar 42 fixed to it. A pair of dependent arms 44 are attached to the bar 42 by pivots 46 and the upper engagement fingers 16 are mounted on the lower ends of the arms. The arm pivots 46 extend through the bar 42 to be secured to meshing gear segments 48 (Fig. 2) and one of the pivots is attached to one end of a link having a roller follower 52 mounted on its opposite, upper end. The roller 52 engages in a slot 54 in a vertical limb 56 of a parallel motion linkage also comprising a pair of parallel links 58 that are pivoted at one end to the vertical limb 56 and at the other end to supports 60 projecting from the fixed front plate 30 of the collator frame. A connector rod 62 is attached at one end to the pivot 64 between the vertical link 56 and the upper parallel link 58 and at the other end to the upper end of a lever 66. The lower end of the lever 66 is pivoted to a backplate 68 of the collator frame and between these pivots the lever has a follower 70 which projects into a rear track 72 of a cam 74 rotatable on a shaft 76 journalled in the backplate 68.

The cam track profile pivots the lever 66 as the cam 74 rotates and drives the rod 62 forwards and backwards. The forward end of the link 62 is constrained to swing in an arc centred on the top pivot of the upper parallel link 58 and the vertical limb 56 similarly performs an arcuate movement. Any vertical component of that movement is not transmitted to the link 50 which is connected to the vertical limb by the roller 52 because the roller can move freely in the elongate slot 54. The horizontal component of the movement of the vertical limb 56 is however transmitted to the link 50, so pivoting it and rocking the gear segment 48 to which it is attached. Because they are intermeshed, the two gear segments 48 therefore perform opposite pivoting movements which swing the arms 44 towards and away from each other, giving the required movements of the upper engagement fingers 16 into and out of the guide.

For the vertical displacement of the upper engagement fingers 16 the carriage 22 is attached to one end of a rod 82 the other end of which is pivoted to a forward arm 84 of a crank 86 journalled in the front plate 30. The crank 86 has a second arm 88 at its rear, behind the front plate, and a follower 90 on the free end of the arm 88 is located in a closed circuit cam track 92 in the front face of the cam 74.

Rotation of the cam 74 thus swings the crank 86 to raise and lower the carriage through the rod 82. The length of the slot 54 in the vertical limb 56 is sufficient to isolate this movement from the finger-pivoting mechanism. The two movements are synchronised because they are originated from the same cam.

The carriage 26 for the lower engagement fingers 18 comprises a carrier plate 102, and arms 104 provided with the fingers 18 are mounted in the carrier plate on parallel vertical pivots 106. The arms 104 are interconnected by meshing gear segments 108, as in the mechanism operating the upper fingers 16. A follower 110 carried by one gear segment 108 locates in a cam track 112 fixed to the front plate 30. The contour of the cam track can displace the follower 110 laterally and so swing the associated gear segment 108 about its pivot. As with the upper fingers, the meshing segments cause both fingers 18 to move oppositely to each other, into and out of the guide column.

The carriage 26 of the lower finger mechanism also has an arm 116 that projects rearwards through a clearance slot in the front plate 30 to be fixed to a vertical run

of an endless belt 118 extending around upper and lower pulleys 120 (Fig. 4). A motor 122 drives the belt through one of the pulleys and so moves the carriage 26 up and down. Because the cam track 112 is fixed in position, the lower engagement finger movements into and out of the guide 2 will always occur at the same vertical positions. The motor drive will determine the timing of those movements.

The pusher member carriage 24 has a rearwardly projecting limb 128 to allow it to be displaced vertically by a belt drive corresponding to that for the lower finger mechanism and indicated by the same reference members in Fig. 5. The pusher member 20 is mounted on an arm 130 that is attached to a vertical pivot 132 on its carriage and an anti-backlash spring 134 urges the pusher member to its forward position, projecting into the guide. (Anti-backlash springs are also provided on the arms 44,104 although they are not shown in the drawings). A lug 136 extending from the arm has a part-spherical follower 138 located in a vertical channel 140 that forms one arm of a further parallel motion linkage. The linkage also includes upper and lower parallel links 142 through which the channel 140 is articulated to fixed arms 144 projecting from the front plate 30. The forward cylindrical track 146 of the cam 74 receives a follower 148 mounted on one end of a lever 150, the other end of which is attached to a fixed pivot 152, and a link 154 connects an intermediate point on the lever with the channel 140.

Rotation of the cam 74 thus pivots the lever 150 which, through the links 142, rocks the vertical channel 140. As there is free relative movement between the channel 140 and the follower 138 in the vertical direction, only the horizontal component of this movement is transmitted by the follower to the arm 130 to retract the pusher from the guide or to reinforce the action of the spring 134 and move it into the guide.

The engagement fingers 16,18 are mounted on pivots 156,158 respectively which allow them to swing up and down. Resilient means (not shown) act to retain the fingers in the horizontal position but are so arranged that this action is overridden if the fingers are tilted beyond a predetermined angle from the horizontal. Thus, if the fingers meet unexpected obstacles, they can assume a deflected position and avoid damage.

A tamper arm 172 is mounted on a pivot shaft 174 to one side of the guide 2 to drive the packets P downwards into the guide as they come from the conveyor. The drive of the tamper arm 172 comprises a crank mechanism 176 (Fig. 3) and is connected to the conveyor drive in order to operate in synchronism with the delivery of the packets. The motors for the movements of the engagement fingers and the pusher member are controlled by a common micro-processor (not shown) so as to coordinate their action. In known manner, an output from packet counting means may input to the processor to regulate the operation of these mechanisms.

The operation of the apparatus described so far will now be explained with reference to the remaining figures of the drawings.

Fig. 6 shows the moment of completion of a stack of articles. The stack rests on the lower engagement fingers 18 but the pusher member 20 and the upper engagement fingers are retracted from the guide.

The guide is located directly over a carton station in which an empty carton C can be placed, its top open, to receive the stack of articles A from the collator. In the preferred arrangement illustrated, the carton interior has substantially the same cross-sectional shape as the guide and forms with the guide an essentially continuous columnar space, the gap between the two being merely sufficient for the free movement of the cartons through the carton station transverse to the axis of the guide.

With the deposit of the final article onto the stack as in Fig. 6, the upper engagement fingers 16 and the pusher member 20 move laterally into the guide. At, or immediately before this stage, an empty carton is brought into position under the guide, with its top open. The apparatus is then in the position shown in Fig. 7.

The lower engagement fingers 18 and the pusher member 20 now move downwards to lower the stack. As the fingers 18 reach the bottom of the guide they are retracted, but the pusher 20 continues downwards at an accelerating rate to drive the stack out of the guide and into the carton (Fig. 9). The acceleration is preferably about 1g or greater to ensure that the articles are effectively held by the pusher member in the same manner as the lower engagement fingers previously held them against gravity. The pusher member is braked to a stop only as it reaches the bottom of the guide (Fig. 9) so as to maintain pressure on the stack until it has almost completely been inserted in the carton. The articles are thereby essentially continuously supported, which prevents them from tumbling or otherwise breaking from their ordered arrangement, which could disrupt the filling of the carton.

While the stack is being discharged, further articles A arriving at the guide collect on the upper engagement fingers. These are moved downwards progressively to maintain the top of the accumulating stack at substantially the same height.

The pusher member 20 is retracted when its downward movement is completed, and it and the already retracted lower engagement fingers 18 are driven upwards. The lower fingers 18 are brought immediately below the level of the upper fingers 16 as shown in Fig. 10, and are extended into the guide while the pusher member remains outside the guide. The filled carton can be transferred from the carton station during and following this stage.

With the extension of the lower engagement fingers 18 into the guide, the upper fingers 16 can be retracted (Fig. 11). The weight of accumulating stack is thereby transferred onto the lower fingers which, like the upper fingers before them, are progressively lowered as the new stack continues to build.

The retracted upper fingers and pusher member rise (Fig. 12) during this stage until, by the time the stack is completed, they have reached their top positions as shown in Fig. 6 and the cycle can be repeated.

Claims

1. Apparatus for handling a stack of articles, comprising a guide for containing the articles as they are gathered in a stack extending longitudinally within the guide, support means on which the building stack rests within the guide, and discharge means behind the stack displaceable longitudinally within the guide to travel with the completed stack as it emerges through an exit end of the guide.

2. Apparatus according to claim 1 wherein the discharge means are displaceable substantially to said one end of the guide in order to continue to travel with the completed stack until it has at least substantially wholly left the guide.

3. Apparatus according to claim 1 or claim 2 comprising means for removing said support means from the path of the stack during the period of said ejection of the stack by the discharge means.

4. Apparatus according to any one of claims 1 to 3 wherein further support means are insertable into the guide to provide a temporary support for a succeeding stack after the completion of each preceding stack, to be replaced by the first said support means after the preceding stack has left the guide.

5. Apparatus according to any one of the preceding claims wherein the guide extends downwardly and the support means provides a base for the building stack.

6. Apparatus according to any one of the preceding claims wherein said discharge means are arranged to accelerate with the completed stack at a rate not substantially less than gravitational acceleration.

7. Apparatus according to claim 5 wherein said discharge means are arranged to drive the completed stack out of the guide with an acceleration greater than the rate of gravitational acceleration.

8. Apparatus according to any one of claims 5 to 7 further comprising a carton station for placing a carton immediately below the guide to receive the stack of articles from the guide.

9. Apparatus for handling a stack of articles, comprising a downwardly extending guide for receiving the articles as the stack is built, lower support means on which the building stack rests in the guide, and discharge means displaceable within the guide to bear on the top of the completed stack and eject it through the bottom of the guide, the discharge means maintaining contact with the top of the stack at least substantially to the bottom of the guide.

10. A method of handling articles including collating the articles in a stack locating an open container longitudinally aligned with the stack and transferring the stack longitudinally into the container while displacing a discharge device behind the stack to travel with the stack at least substantially to an exit end of the guide as the stack emerges through said exit end, to control the stability of the stack during transfer to the container.

11. A method according to claim 10 wherein the discharge means applies an acceleration to the stack during said transfer.

12. A method according to claim 11 wherein said accelerating force is maintained until substantially the complete stack of articles has been transferred into the container.

13. A method according to claim 11 or claim 12 wherein the stack is built in a downwardly extending guide and is transferred to a container below the guide by accelerating it at a rate greater than that of gravitational acceleration.

14. A method according to any one of claims 10 to 13 wherein during the transfer of each completed stack, a continuing supply of articles is collected in the guide to begin a further stack in line with the completed stack being transferred.

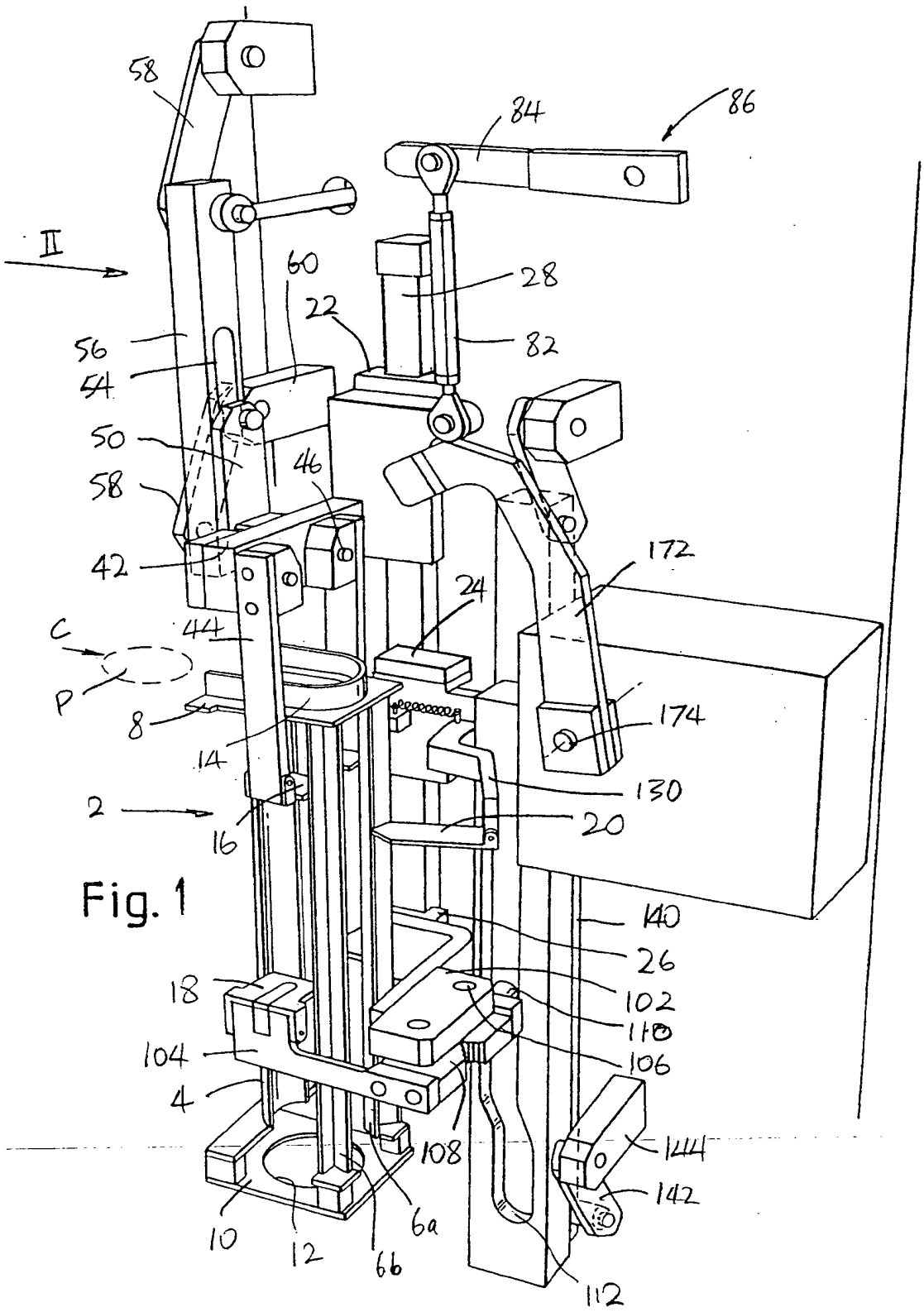

Fig. 1

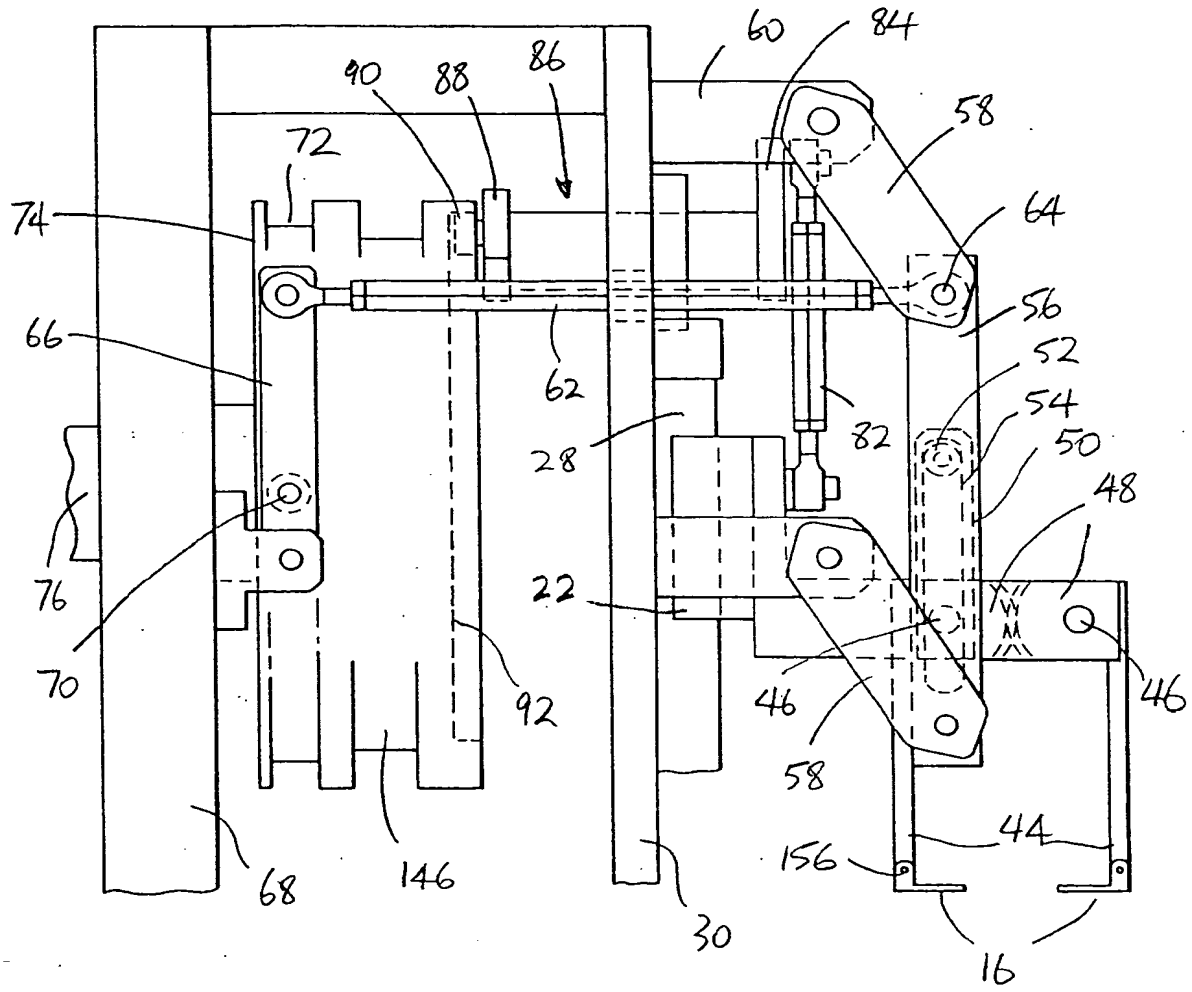

Fig. 2

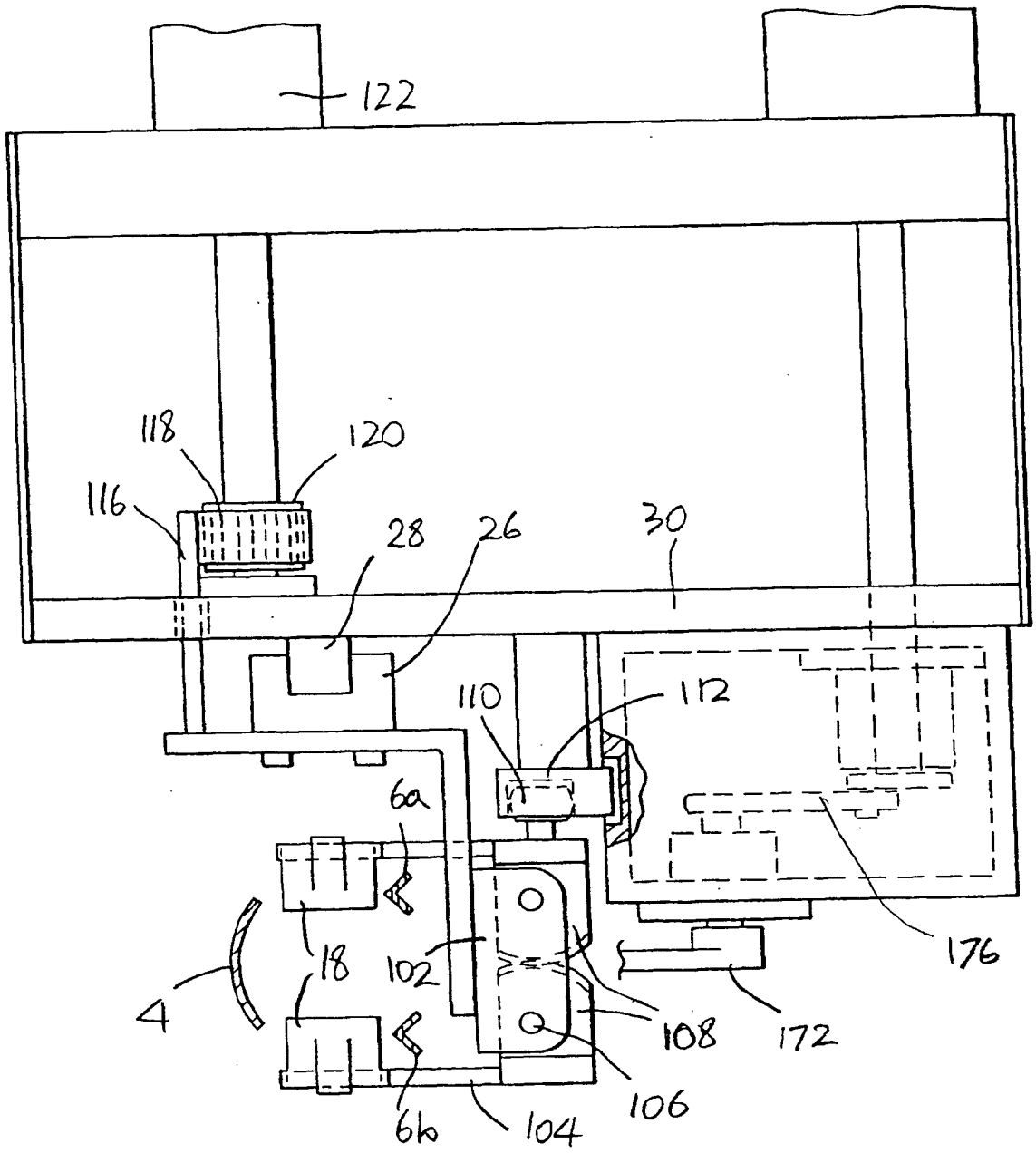

Fig. 3

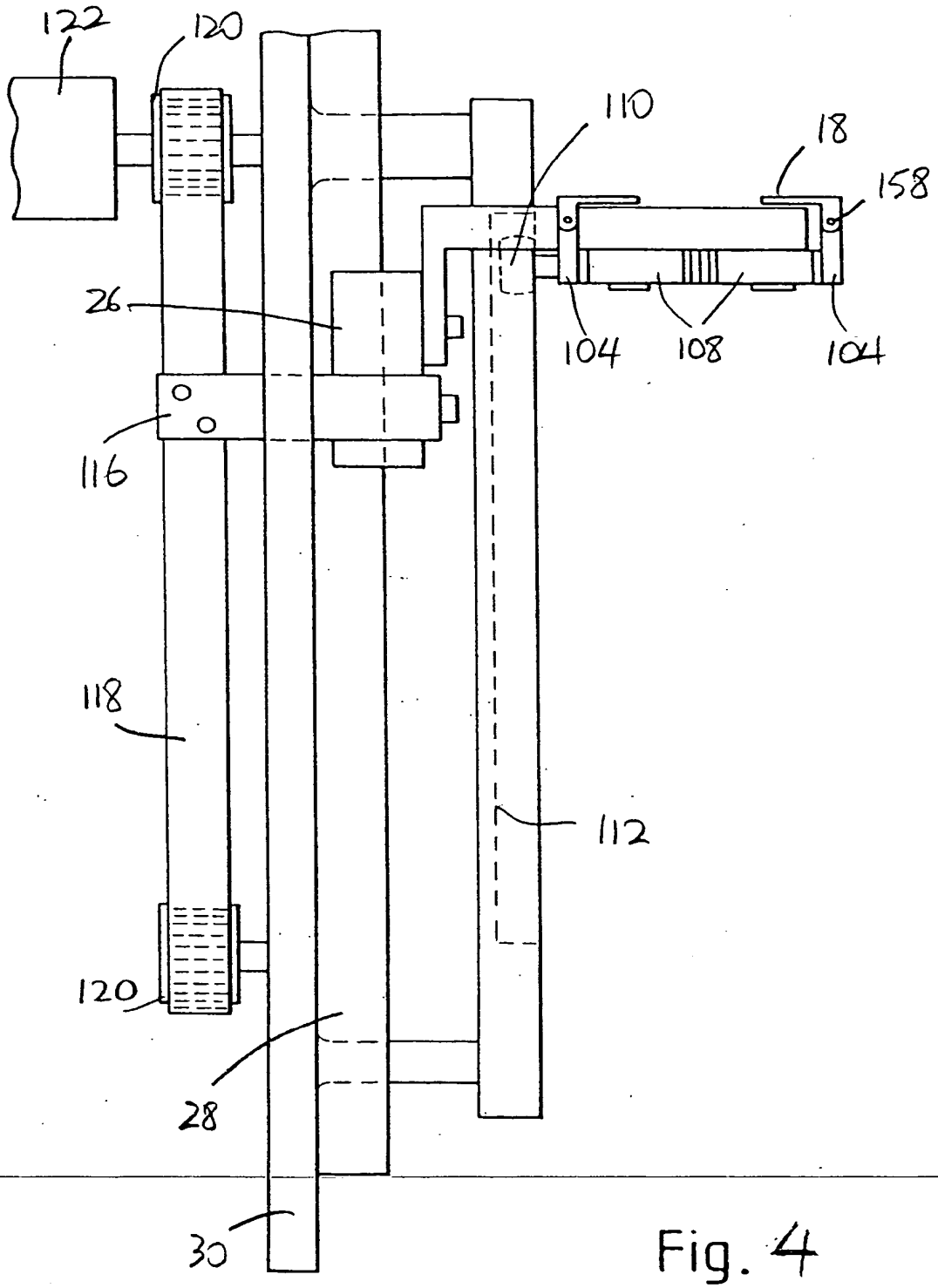

Fig. 4

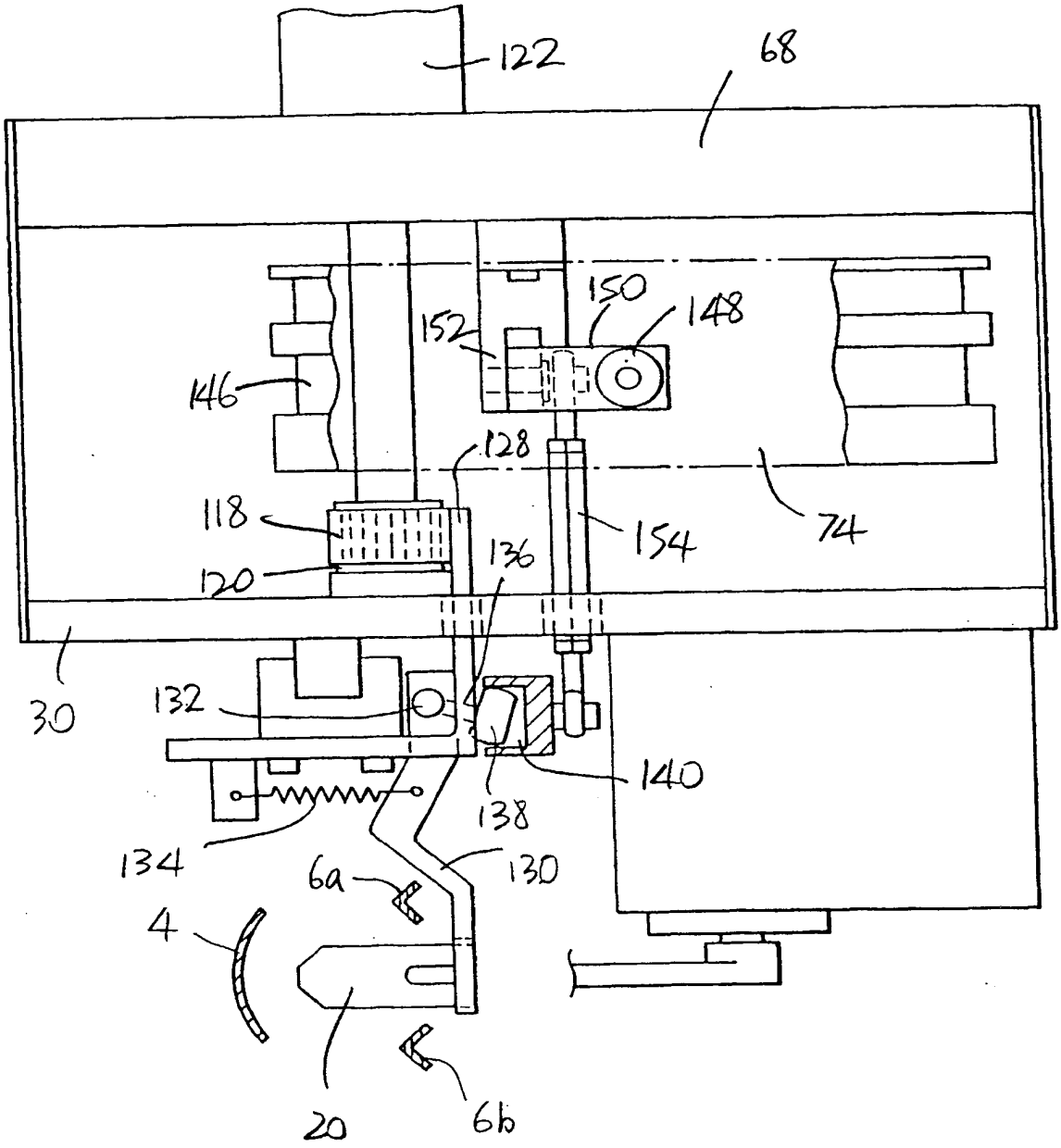

Fig. 5

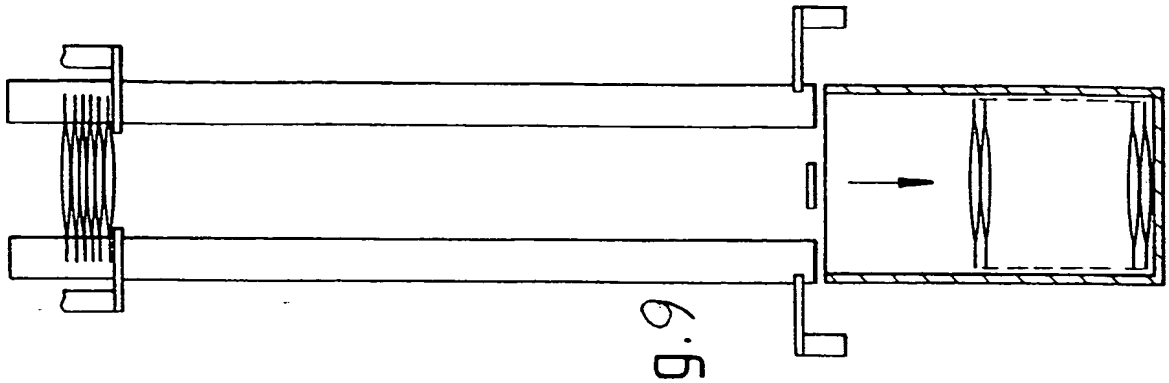

Fig.9

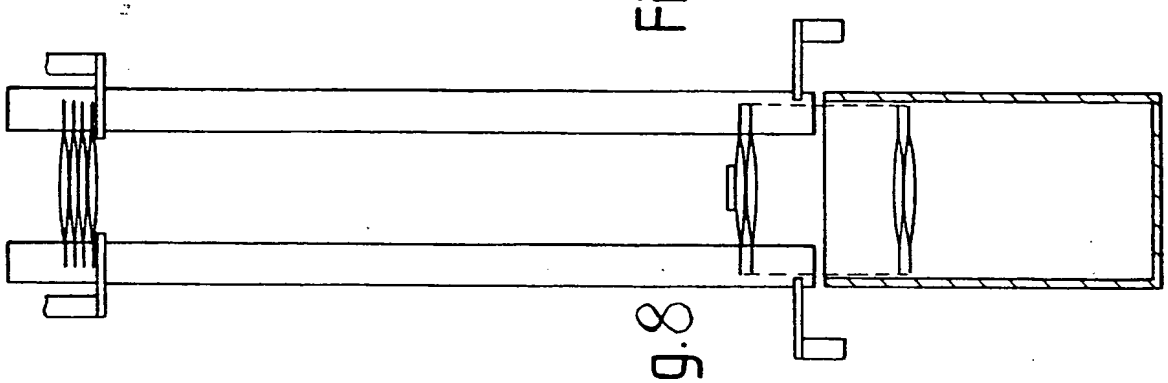

Fig.8

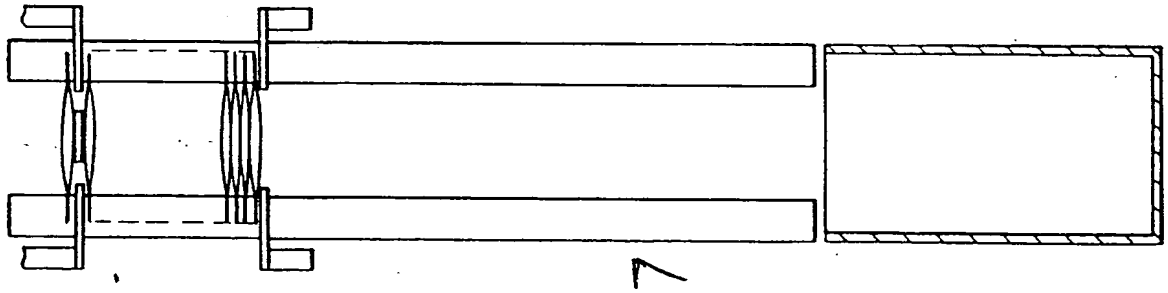

Fig.7

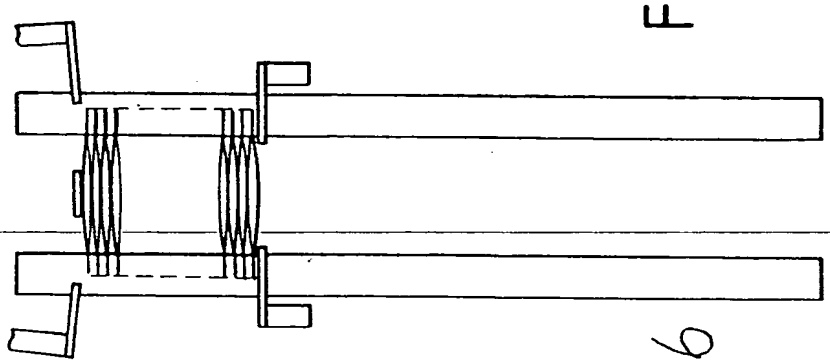

Fig.6

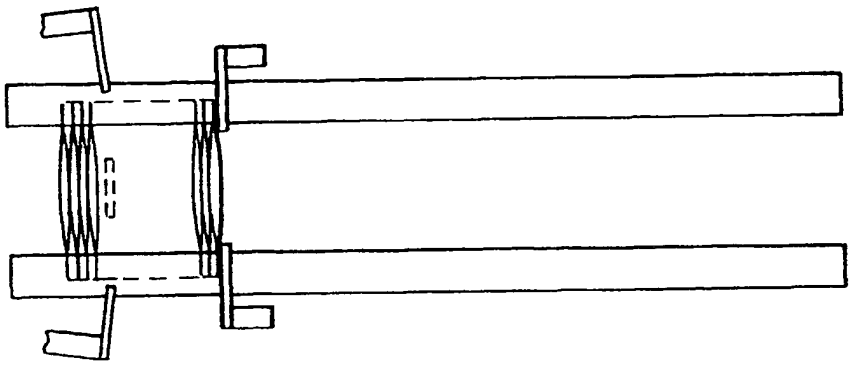

Fig. 12

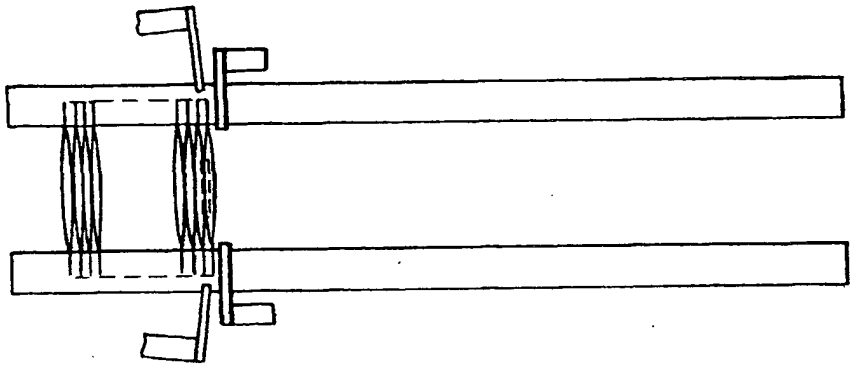

Fig. 11

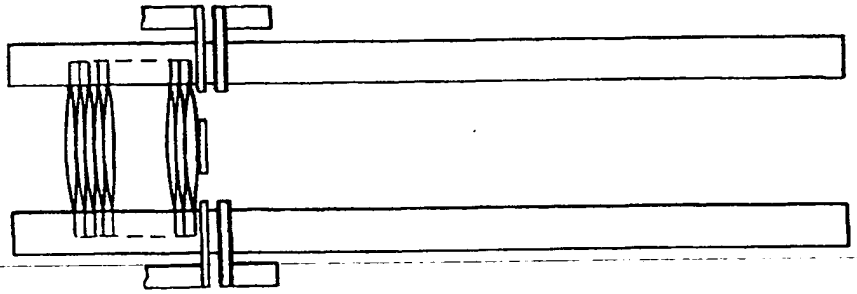

Fig. 10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 1197

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US-A-4 086 745 (O.M. CAUDLE) 2 May 1978 * column 8, line 63 - column 9, line 16; figure 9 *	1-3,5, 8-10	B65B5/06
X	DE-C-43 42 112 (TEEPACK SPEZIALMASCHINEN) 2 February 1995 * column 3, line 64 - column 4, line 33; figures 1,2 *	1-4	
X	EP-A-0 248 576 (FIBERGLAS CANADA) 9 December 1987 * figures 1,4 *	1-5,9	
X	US-A-2 577 765 (H.O. IRMSCHER) 11 December 1951 * column 3, line 12-23; figures 1,2 *	1,2,10, 11	
A	DE-A-37 36 868 (BENZ & HILGERS) 11 May 1989 * figure 7 *	3,4,14	
A	US-A-3 893 282 (M.L. ARMBRUSTER ET AL.) 8 July 1975 * column 5, line 59 - column 6, line 16; figures 3-5 *	1-3,5,6, 8-11	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B65B B65G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 June 1996	Grentzius, W

CATEGORY OF CITED DOCUMENTS

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